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Editorial: Africa's Contributions to Information Systems

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**Richard T. Watson
Department of MIS
University of Georgia
rwatson@terry.uga.edu**

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ABSTRACT

Africans created the world's first major information systems, gesturing and language. Now days, Africa is once again showing leadership in the area of frugal IS.

Keywords:

Gesturing, language, frugal information systems, u-constructs

AFRICA'S CONTRIBUTIONS TO INFORMATION SYSTEMS

The African origins of Information Systems

In my search for learning about information systems, I took a broader path to the quest a few years ago by recognizing that information systems have existed for thousands of years (Watson, forthcoming). I observed that information systems did not start about five decades ago with the application of digital computers to organizational data processing. Rather, humans have been developing and using information systems for tens of thousands of years. Humans are a cooperative social species with exceptional information processing capability. In order to cooperate, humans used their information processing capability to develop systems for mutually sharing information. The first of these information systems were developed in Africa, and they are still currently in widespread use.

We are descendants of those Africans who became efficient (detected and processed information quickly) and effective (made the correct decisions based on their processing of perceived data) at handling information. Along the evolutionary journey, those who processed information poorly did not survive. We are the descendants of those ancient Africans who were more efficient and effective information processors. In addition, information can be a valuable survival tool. Our better-informed forebears were more able to solve survival problems, and thus more likely to have descendants. For instance, knowing the whereabouts of waterholes enables today's Bushmen to survive in the harsh Kalahari Desert, just as it did for their forebears.

The first African information system was likely a collection of gestures, because human cooperation and communication originated as pointing and pantomiming (Tomasello, 2008, p. 11). These forms of information exchange emerge before speech in the development of a human infant. Babies gesture innately, but their parents and siblings teach them speech. We often revert to gestures when there is not a shared language or where noise or distance makes speech difficult.

Phonemic diversity indicates that language, the second information system created by Africans, originated about 350,000 to 150,000 years ago (Perreault & Mathew, 2012). As human groups migrated out of Africa about 60,000 to 70,000 years ago, there was a loss of phonemic diversity (Atkinson, 2011). As a result, African languages today have some of the largest inventories of phonemes. For example, the !Xun language found in Southern Africa has 141 phonemes whereas some regions, such as South America, to which humans migrated more recently, have fewer phonemes. Thus, Pirahã, spoken in South America, has 11 phonemes (Perreault & Mathew, 2012).

Mastering of gesturing, and later language, likely increased the survival prospects of early humans. Group hunting, for instance, has decided advantages, such as herding animals over a cliff or towards an ambush and thus is more likely to be successful than hunting alone. Mutual cooperative information exchange through gesturing or speech enabled humans to coordinate their actions for hunting, building housing, fighting, and other activities that enhanced the passing on of their genes to the next generation. Human collaboration using information relies on a psychological infrastructure of shared goals or intentionality to support collaborative efforts (Tomasello, 2008, p. 12). We evolved to both communicate and interpret mutual goals to enable joint task completion. Our African heritages created a social species that is very competent in processing information and collaborating.

Information systems in the form of gesturing and language, as we learned previously, have been part of the human social repertoire for hundreds of thousands of years. Information systems further developed when early Africans started to apply technology to common tasks. A thoughtful few among our ancestors realized that some activities, such as skinning a beast (a task), could be improved by using the sharp edge of a rock as a proto-knife (a technology). This realization hatched another task, using a hammerstone to shape rocks with sharp edges. The emergence of a new technology is lost unless an information system is created to transmit use of the technology. We can imagine that a sequence of gestures and verbal instructions were developed to train others in using a proto-knife to butcher a carcass. Thus a new task, instructing others in the use of a proto-knife and hammerstone, emerged. Once this cycle commenced, humans began accumulating technology and associated information systems to enable the transfer of essential knowledge within and across generations for the growing range of tasks our ancestors invented over the millennia.

The major information system inventions developed in the African savannah were gesturing and speech, and these spawned minor information systems, such as creating a proto-knife. Thus, when humans left Africa they took with them some fundamental information processing and transmission skills.

The impetus for information systems development passed from Africa to other regions of the world because some humans migrated to regions that were particularly well-suited for the establishment of farming (Diamond, 1997), such as the Middle East, where there were wild cereals and animals that could be easily domesticated. With the development of agriculture and the concomitant creation of large permanent settlements, a new set of information systems were needed, such as arithmetic, geometry, writing, measuring systems, astronomy, and currency. Dominant logic theory (Watson, Lind, & Haraldson, 2012) argues that the principle problem of an economic era determines what information systems are developed. Africa was the birthplace of gesturing and language because these were essential for a hunting and gathering lifestyle, but when farming started in other parts of the world, Africa lost its early lead in information systems.

Regaining a leadership position in Information Systems

Over time, the impetus for information systems innovation moved from the early agriculture societies to other parts of the world, such as Greece (an alphabet with vowels), Germany (a printing system), and the United States (digital computers). Africa became a long-term importer of information systems and associated technology. Importers, however, can be innovators, especially when local conditions vary considerably from those where a technology emerged.

Mobile phones were developed in Europe and North America for a relatively affluent clientele. Most of these people already had a landline, but quickly appreciated the convenience of a mobile phone. In contrast, few Africans have ever had a landline because of the high infrastructural costs of cable-based telephony. Mobile phone technology, fortunately, enabled African countries to leapfrog landline technology and install the cheaper and more useful cell phone system. The low cost of mobile phones means that they are affordable for many people living in less wealthy economies. The ITU estimates that in 2013, 63.5 percent of Africans have a mobile subscription compared to 126.5 percent in Europe.¹ Internet penetration is much lower, with 16.3 percent of Africans using the Internet compared to 74.7 percent of Europeans. Consequently, the mobile phone is the interface to information systems for most Africans.

The high penetration rate of mobile phones and the low per capita income in many countries has created a set of circumstances that has stimulated the development of a new class of information systems in Africa and other developing economies. This new category is called a frugal IS, which is “... *an information system that is developed and deployed with minimal resources to meet the preeminent goal of the client*” (Watson, Kunene, & Islam, 2013). There are two important aspects to this definition. *First*, there is a focus on using minimal resources. *Second*, the prime needs of the client must be accomplished. A frugal IS should have a single prime design goal. This constrained scope should preclude consideration of secondary goals, which typically add to the cost of development and increase the complexity of learning how to use an application. In most of Africa, per capita incomes are low, and the little discretionary income that people have needs to be spent on information that is essential to meeting their daily needs.

¹ <http://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx>

The success of an IS, including a frugal IS for serving people in emerging economies, is dependent on how well it satisfies the four information drives (Junglas & Watson, 2006). The mobile phone's great value derives from its ability to meet the drives of ubiquity and uniqueness at low cost. A system of cell towers gives most urban dwellers in Africa ubiquitous access to information. A mobile phone is a personal device, and its owner is uniquely identified through a SIM card. Because of ubiquity, mobile phones can connect to databases, and thus a person can get a single integrated view of information, thus accomplishing the unison drive. Finally, mobile phones, particularly in the form of smart phones, are become highly integrated sets of information systems (e.g., use of GPS and a map to show shoe stores in the vicinity of the phone's owner). Instead of using multiple, independent information systems, the smart phone can deliver for its owner an integrated view from several information systems. The smart phone meets the drive for universality because it enables the integration of a bundle of compatible apps that greatly reduce the friction between different information systems.

Table 1: The information drives (Junglas & Watson, 2006)

Drive	Definition
Ubiquity	The drive to access to information unconstrained by time and space
Uniqueness	The drive to know precisely the characteristics and location of a person or entity
Unison	The drive for information consistency
Universality	The drive to overcome the friction of information systems' incompatibilities

Because the economies of many African countries are in the developing stage, the region has become a leader in developing frugal information systems. Ushadidi.com, a frugal IS for gathering information during a crisis situation, was developed in Kenya in 2007. It has evolved into "open source software for information collection, visualization, and interactive mapping" (Ushahidi.com, 2011), and has since been used in South Africa (violence), the Democratic Republic of Congo (violence), Haiti (earthquake), New Zealand (earthquake), and Japan (earthquake). According to the *Economist*, Kenya leads the world in mobile banking (The Economist, 2013) through M-PESA (Ngugi, Pelowski, & Ogembo, 2010), which is an exemplar of frugal IS thinking.

The practice of frugal IS design does not limit applications to areas of low complexity. A basic cell phone is simple to use, but a highly complex telecommunications network supports it. A frugal IS can be dependent on an intricate infrastructure, but the complexity of the infrastructure needs to be invisible, and it needs to contribute to the inexpensiveness of the solution. Complex network structures, such as the Internet and cell phone system, can provide basic services inexpensively because economies of scale have lowered the cost of deployment and use over time. The great opportunity for African IS designers is to combine their knowledge of local needs and conditions with an in-depth understanding of advanced communications technology to create frugal information systems that meet the needs of citizens in the world's developing economies.

Once the sole leader in information systems development, Africa is now demonstrating that it can be a leader in frugal IS. It has the requisite domain knowledge of the needs of consumers and organizations in developing economies to design and implement systems that meet their requirements. This is a large global market, as many people still live close to the poverty line. African IS entrepreneurs can use their skills to serve this larger market, as some are already

doing. African IS academics can study the phenomenon of frugal IS and imbue their students with the skills to design and build frugal systems. Africa once again can make a major contribution to enhancing living standards through information systems innovation.

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